

SINGLE SENSING MULTIPLE OUTPUT SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates generally to a sensing system including a single sensor element and multiple sensor outputs and, more particularly, to a sensing system in a vehicle that employs a single sensor element and multiple sensor outputs, where the system uses the multiple outputs for diagnostic purposes.

2. Discussion of the Related Art

[0002] Sensing systems are employed in vehicles for sensing the condition, position, performance, etc. of certain vehicle systems and devices. For example, sensing systems are used for sensing throttle plate position in an electronic throttle body of a vehicle. When an operator of the vehicle presses the accelerator pedal, the accelerator pedal position is detected. The throttle plate position is sensed by a sensing system that provides an output signal to the engine controller of the position. The engine controller provides the proper amount of fuel and air to operate the engine at the desired speed.

[0003] Sensor systems of this type can employ two sensor elements for redundancy purposes. The two sensor elements provide two separate sensor output signals to the engine controller. The two output signals are typically different relative to each other, such as having reversed slopes, truncated slopes, etc., so that the two output signals change differently under normal conditions during the sensing operation. The engine controller compares the two output signals to make a determination as to

whether the sensors and associated circuitry are operating properly. If one of the sensors fails, or sensor circuitry fails, or sensor connections fail, the corresponding output signal will go out of its normal operating range relative to the other sensor output signal or into a diagnostic range. For example, if a change in the supply voltage to one of the sensor elements changes, its output signal will behave differently than if the supply voltage was unaffected. By comparing the two sensor output signals, the engine controller will thus know if the sensing system is operating properly.

[0004] Each sensor element and its associated circuitry are typically provided in a separate circuit, where redundant sensors require two separate chips. This adds additional cost to the system because of the cost of the circuits. It would be desirable to provide two sensor output signals from a sensing system of this type for sensing system diagnostic purposes, yet only have a single sensor element and its associated circuitry on a single chip.

SUMMARY OF THE INVENTION

[0005] In accordance with the teachings of the present invention, a sensing system is disclosed that includes a single sensor element with multiple output signals, such as two output signals. The sensing system includes shared circuits that are shared by all of the output circuits, such as amplifiers, oscillators, analog-to-digital and digital-to-analog converters, etc. A controller is responsive to the multiple output signals, and a supervisor circuit on the chip monitors the sensing element and the shared circuits.

[0006] If the sensor element fails, all of the output signals will go outside of their normal operating range, and thus the controller can take the appropriate action for a failed system. If one of the connectors for one of the output circuits fails, the controller will receive one output signal that is outside the normal operating range of the system relative to the other output circuit, and one output signal that is within the normal operating range, and can take the appropriate action for such a situation. If one of the shared circuits fails, the supervisor circuit will cause all of the output signals to go outside the normal operating range, also providing an indication to the controller of a problem for diagnostic purposes.

[0007] Additional advantages and features of the present invention will become apparent from the following description and appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0008] Figure 1 is a schematic block diagram of a sensing system including one sensor element and multiple outputs, according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0009] The following discussion of the embodiments of the invention directed to a sensing system including a single sensor element and multiple sensor outputs is merely exemplary in nature, and is in no way intended to limit the invention or its applications or uses. For example, the sensing system discussed herein has

particular application for sensing a system or device in a vehicle, for example, a throttle plate position. However, as will be appreciated by those skilled in the art, the sensing system of the invention will have a much wider application.

[0010] Figure 1 is a schematic block diagram of a sensing system 10 that includes a single sensor element 12 and multiple output signals from a first output circuit 14 and a second output circuit 16. The output signals from the output circuits 14 and 16 are provided to a controller 18, such as an engine controller on a vehicle. The sensing system 10 measures or detects a certain parameter. In one embodiment, the sensing system 10 senses a vehicle parameter, such as a throttle plate position. The sensor element 12 can be any sensor element suitable for any of these applications, such as a Hall-effect sensor, an inductive sensor, a magneto-resistive sensor, a potentiometer, encoders, etc. The sensor element 12 receives a supply voltage input, such as 5 volts, on a supply line 22 and is coupled to ground on line 24.

[0011] The output signal of the sensor element 12 is typically an analog voltage signal, and is applied to a series of shared circuits 26 associated with the system 10. The shared circuits 26 can be any necessary circuits that are shared by both of the output circuits 14 and 16, such as amplifiers, analog-to-digital converters, filters, etc. In certain designs, there may not be any shared circuits between the output circuits 14 and 16. The sensor system 10 can also include peripheral circuits 28 that are necessary for the operation of the system 10, such as oscillators, amplifiers, etc. One of normal skill in the art would readily recognize the various circuits that would need to be provided in the shared circuits 26 and the peripheral shared circuits 28 for the particular sensing system.

[0012] The output circuits 14 and 16 provide the multiple output signals of the system 10, and include appropriate output circuitry, such as digital-to-analog converters, driver circuitry, etc. The output signals from the output circuits 14 and 16 can change differently in response to the measured parameter, as discussed above for the known multiple output circuits of the prior art. For example, the output signals could vary as a function of angular position and could have similar or opposing slopes, i.e. one output signal could vary from 0.5 to 4.65 volts and the other output signal could vary from 4.5 to 0.35 volts within the total angular range of the throttle body as a function of the measured parameter.

[0013] A supervisor circuit 30 monitors the operation of the various circuits within the system 10, including the sensor element 12, the shared circuits 26, and the peripheral shared circuits 28. The supervisor circuit 30 can be any type of circuit that is able to monitor the operating conditions of the circuits within the system 10, and many types of circuits would be applicable for this purpose, as would be appreciated by those skilled in the art.

[0014] The sensor element 12 will provide a signal within a certain range during normal operation. Therefore, if the output signals from the output circuits 14 and 16 are not within this range, i.e., are in a diagnostic range, the controller 18 will know that a problem exists, and will take the necessary and predetermined steps, such as provide a warning light on the vehicle dashboard, go into a safe limp home mode, shut the engine down, etc. If a circuit component within the shared circuits 26 or the peripheral shared circuits 28 fails, then the supervisor circuit 30 will provide an output to the controller 18 through the output circuits 14 and 16 to indicate a problem. For

example, a failure of any shared circuit 26 could result in a diagnostic output signal of the two output signals between 0 and 0.25 volts or 4.75 and 5 volts. The controller 18 can then take the appropriate action for this type of a failure. Also, if any of the connectors between the supply line 22 and the sensor element 12 or the ground line 24 and the sensor element 12, or the connections between the output circuits 14 and 16 and the controller 18 fail, the controller 18 will respond accordingly because the output signal of one or both of the output circuits 14 and 16 will be outside the normal operating range of the sensing system 10.

[0015] Thus, the system 10 can provide the multiple output signals for diagnostic purposes to monitor the various conditions of the system 10, without providing two sensor elements. Because a single sensor element is provided, that sensor element and the associated circuits discussed above can be provided on the same integrated circuit chip, thus saving chip cost.

[0016] The foregoing discussion discloses and describes merely exemplary embodiments of the present invention. One skilled in the art will readily recognize from such discussion and from the accompanying drawings and claims, that various changes, modifications and variations can be made therein without departing from the spirit and scope of the invention as defined in the following claims.